

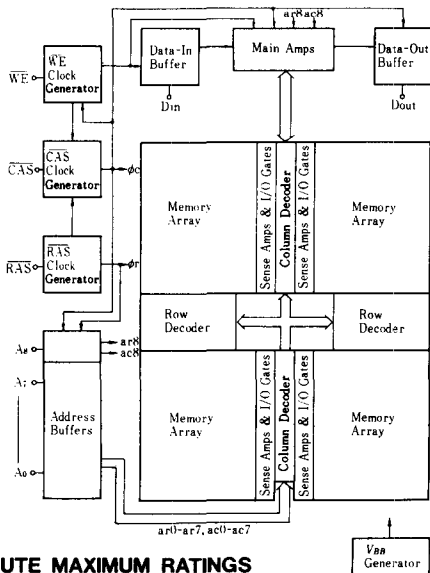
# HM50256-12, HM50256-15, HM50256-20, HM50256P-12, HM50256P-15, HM50256P-20

262144-word × 1-bit Dynamic Random Access Memory

## ■ FEATURES

- Industry Standard 16-Pin DIP
- Single 5V (±10%)
- On chip substrate bias generator
- Low Power: 350mW active, 20mW standby
- High speed: Access Time 120ns/150ns/200ns(max.)
- Common I/O capability using early write operation
- Page mode capability
- TTL compatible
- 256 refresh cycles . . . (4ms)
- 3 variations of refresh . . .  $\overline{\text{RAS}}$  only refresh,  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh, Hidden refresh

## ■ BLOCK DIAGRAM



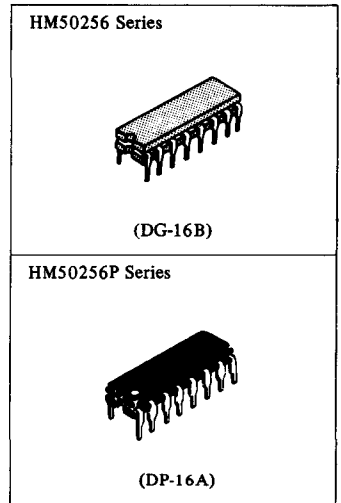
## ■ ABSOLUTE MAXIMUM RATINGS

- Voltage on any pin relative to  $V_{SS}$  . . . . . -1V to +7V  
 Operating temperature,  $T_a$  (Ambient) . . . . . 0°C to +70°C  
 Storage temperature . . . . . (Cerdip) -65°C to +150°C  
 . . . . . (Plastic DIP) -55°C to +125°C  
 Power dissipation . . . . . 1W  
 Short circuit output current . . . . . 50mA

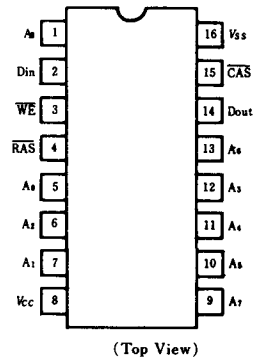
## ■ RECOMMENDED DC OPERATING CONDITIONS ( $T_a=0$ to +70°C)

Parameter	Symbol	min	typ	max	Unit	Note
Supply Voltage	$V_{CC}$	4.5	5.0	5.5	V	1
Input High Voltage	$V_{IH}$	2.4	—	6.5	V	1
Input Low Voltage	$V_{IL}$	-1.0	—	0.8	V	1

Note) 1. All voltages referenced to  $V_{SS}$



## ■ PIN ARRANGEMENT



$A_0 \sim A_8$	Address Inputs
CAS	Column Address Strobe
Din	Data In
Dout	Data Out
$\overline{\text{RAS}}$	Row Address Strobe
$\overline{\text{WE}}$	Read/Write Input
$V_{CC}$	Power (+5V)
$V_{SS}$	Ground
$A_0 \sim A_7$	Refresh Address Inputs

■ DC ELECTRICAL CHARACTERISTICS ( $T_a=0$  to  $+70^\circ\text{C}$ ,  $V_{CC}=5\text{V}\pm 10\%$ ,  $V_{SS}=0\text{V}$ )

Parameter	Symbol	HM50256/P-12		HM50256/P-15		HM50256/P-20		Unit	Notes
		min	max	min	max	min	max		
Operating Current( $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ Cycling : $t_{AC}=\text{min}$ )	$I_{CC1}$	—	83	—	70	—	55	mA	1
Standby Current( $\overline{\text{RAS}}=V_{IH}$ , $\text{Dout}=\text{High Impedance}$ )	$I_{CC2}$	—	4.5	—	4.5	—	4.5	mA	
Refresh Current( $\overline{\text{RAS}}$ only Refresh, $t_{AC}=\text{min}$ )	$I_{CC3}$	—	62	—	53	—	42	mA	
Standby Current( $\overline{\text{RAS}}=V_{IH}$ , $\text{Dout Enable}$ )	$I_{CC5}$	—	10	—	10	—	10	mA	1
Refresh Current( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Refresh, $t_{AC}=\text{min}$ )	$I_{CC4}$	—	69	—	58	—	45	mA	
Input leakage( $0 < V_{in} < 7\text{V}$ )	$I_{LI}$	-10	10	-10	10	-10	10	$\mu\text{A}$	
Output leakage( $0 < V_{out} < 7\text{V}$ )	$I_{LO}$	-10	10	-10	10	-10	10	$\mu\text{A}$	
Output levels High( $I_{out} = -5\text{mA}$ )	$V_{OH}$	2.4	$V_{CC}$	2.4	$V_{CC}$	2.4	$V_{CC}$	V	
Output levels Low( $I_{out} = 4.2\text{mA}$ )	$V_{OL}$	0	0.4	0	0.4	0	0.4	V	

Notes) 1.  $I_{CC}$  depends on output loading condition when the device is selected.  $I_{CC}$  max is specified at the output open condition.

■ CAPACITANCE ( $V_{CC}=5\text{V}\pm 10\%$ ,  $T_a=25^\circ\text{C}$ )

Parameter	Symbol	typ	max	Unit	Notes
	Clocks, Data-out	$C_{O2}$	—	7	1, 2

Notes) 1. Capacitance measured with Bonton Meter or effective capacitance measuring method.  
 2.  $\text{CAS} = V_{IH}$  to disable Dout.

■ ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

( $T_a=0$  to  $+70^\circ\text{C}$ ,  $V_{CC}=5\text{V}\pm 10\%$ ,  $V_{SS}=0\text{V}$ )<sup>1), 10), 11)</sup>

Parameter	Symbol	HM50256/P-12		HM50256/P-15		HM50256/P-20		Unit	Notes
		min	max	min	max	min	max		
Access Time from $\overline{\text{RAS}}$	$t_{RAC}$	—	120	—	150	—	200	ns	2, 3
Access Time from $\overline{\text{CAS}}$	$t_{CAC}$	—	60	—	75	—	100	ns	3, 4
Output Buffer Turn-off Delay	$t_{OFF}$	—	30	—	40	—	50	ns	5
Transition Time(Rise and Fall)	$t_T$	3	50	3	50	3	50	ns	6
Random Read or Write Cycle Time	$t_{RC}$	220	—	260	—	330	—	ns	
$\overline{\text{RAS}}$ Precharge Time	$t_{RP}$	90	—	100	—	120	—	ns	
$\overline{\text{RAS}}$ Pulse Width	$t_{RAS}$	120	10000	150	10000	200	10000	ns	
$\overline{\text{CAS}}$ Pulse Width	$t_{CAS}$	60	10000	75	10000	100	10000	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Delay Time	$t_{RCD}$	25	60	25	75	30	100	ns	7
$\overline{\text{RAS}}$ Hold Time	$t_{RSH}$	60	—	75	—	100	—	ns	
$\overline{\text{CAS}}$ Hold Time	$t_{CSH}$	120	—	150	—	200	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time	$t_{CRP}$	10	—	10	—	10	—	ns	
Row Address Set-up Time	$t_{ASR}$	0	—	0	—	0	—	ns	
Row Address Hold Time	$t_{RAH}$	15	—	15	—	20	—	ns	
Column Address Set-up Time	$t_{ASC}$	0	—	0	—	0	—	ns	
Column Address Hold Time	$t_{CAH}$	20	—	25	—	30	—	ns	
Column Address Hold Time referenced to $\overline{\text{RAS}}$	$t_{AR}$	80	—	100	—	130	—	ns	
$\overline{\text{WE}}$ Command Set-up Time	$t_{WCS}$	0	—	0	—	0	—	ns	8
Write Command Hold Time	$t_{WCH}$	40	—	45	—	55	—	ns	
Write Command Hold Time referenced to $\overline{\text{RAS}}$	$t_{WCR}$	100	—	120	—	155	—	ns	
Write Command Pulse Width	$t_{WP}$	40	—	45	—	55	—	ns	
Write Command to $\overline{\text{RAS}}$ Lead Time	$t_{RWL}$	40	—	45	—	55	—	ns	
Write Command to $\overline{\text{CAS}}$ Lead Time	$t_{CWL}$	40	—	45	—	55	—	ns	
Data-in Set-up Time	$t_{DS}$	0	—	0	—	0	—	ns	9
Data-in Hold Time	$t_{DH}$	40	—	45	—	55	—	ns	8, 9
Data-in Hold Time referenced to $\overline{\text{RAS}}$	$t_{DHR}$	100	—	120	—	155	—	ns	
Read Command Set-up Time	$t_{RCS}$	0	—	0	—	0	—	ns	
Read Command Hold Time referenced to $\overline{\text{CAS}}$	$t_{RCH}$	0	—	0	—	0	—	ns	
Read Command Hold Time referenced to $\overline{\text{RAS}}$	$t_{RRH}$	10	—	10	—	10	—	ns	
Refresh Period	$t_{REF}$	—	4	—	4	—	4	ms	

(to be continued)

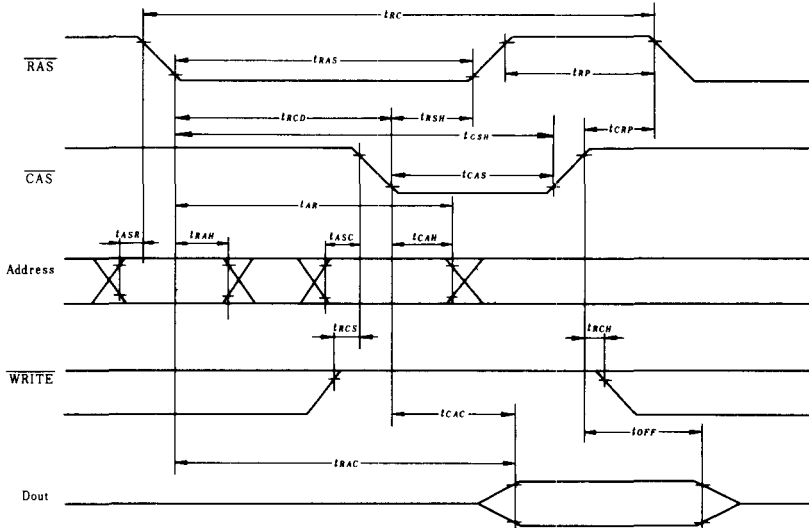
Parameter	Symbol	HM50256/P-12		HM50256/P-15		HM50256/P-20		Unit	Notes
		min	max	min	max	min	max		
Read-Write Cycle Time	$t_{RWC}$	265	—	310	—	390	—	ns	
CAS to WE Delay	$t_{CWD}$	60	—	75	—	100	—	ns	8
RAS to WE Delay	$t_{RWD}$	120	—	150	—	200	—	ns	
CAS Precharge Time	$t_{CPN}$	50	—	60	—	80	—	ns	
CAS Setup Time	$t_{CSR}$	10	—	10	—	10	—	ns	
CAS Hold Time (CAS before RAS Refresh)	$t_{CHR}$	120	—	150	—	200	—	ns	
RAS Precharge to CAS Hold Time	$t_{RPC}$	0	—	0	—	0	—	ns	

Notes

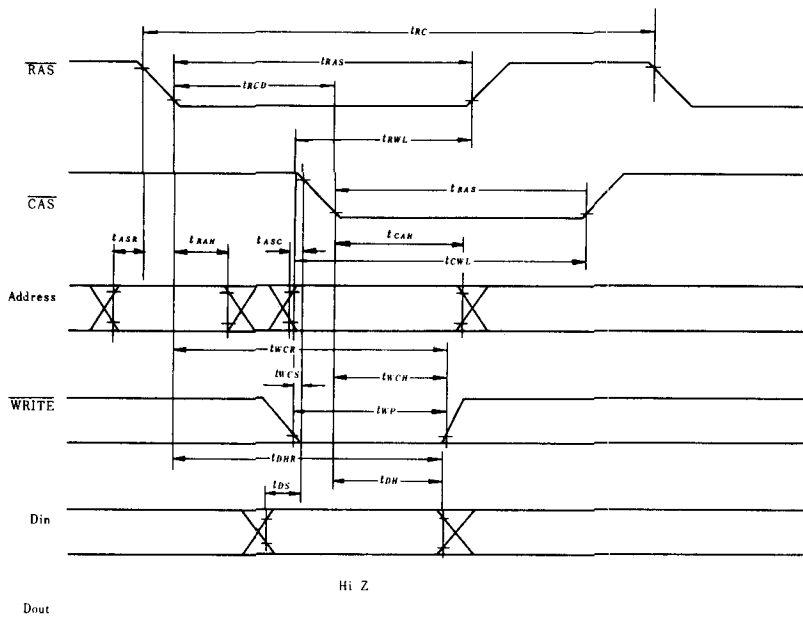
- AC measurements assume  $t_T = 5ns$ .
- Assumes that  $t_{RCD} \leq t_{RCD} (max)$ . If  $t_{RCD}$  is greater than the maximum recommended value shown in this table,  $t_{RAC}$  exceeds the value shown.
- Measured with a load circuit equivalent to 2TTL loads and 100pF.
- Assumes that  $t_{RCD} \geq t_{RCD} (max)$ .
- $t_{OFF}$  (max) defines the time at which the output achieves the open circuit condition and output voltage levels are not referred.
- $V_{IH}$  (min) and  $V_{IL}$  (max) are reference levels for measuring timing of input signals. Also, transition times are measured between  $V_{IH}$  and  $V_{IL}$ .
- Operation with the  $t_{RCD}$  (max) limit insures that  $t_{RAC}$  (max) can be met,  $t_{RCD}$  (max) is specified as a reference point only; if  $t_{RCD}$  is greater than the specified  $t_{RCD}$  (max) limit, access time is controlled exclusively by  $t_{CAC}$ .
- $t_{WCS}$ ,  $t_{CWD}$  and  $t_{RWD}$  are not restrictive operating parameters.  
They are included in the data sheet as electrical characteristics only; if  $t_{WCS} \geq t_{WCS} (min)$ , the cycle is an early write cycle and the data output pin will remain open circuit (high impedance) throughout the entire cycle; if  $t_{CWD} \geq t_{CWD} (min)$  and  $t_{RWD} \geq t_{RWD} (min)$ , the cycle is a read-write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied the condition of the data out (at access time) is indeterminate.
- These parameters are referenced to CAS leading edge in early write cycles and to WE leading edge in delayed write or read-modify-write cycles.
- An initial pause of 100 $\mu s$  is required after power-up then execute at least 8 initialization cycles.
- At least, 8 CAS before RAS refresh cycle are required before using internal refresh counter.

■ TIMING WAVEFORMS

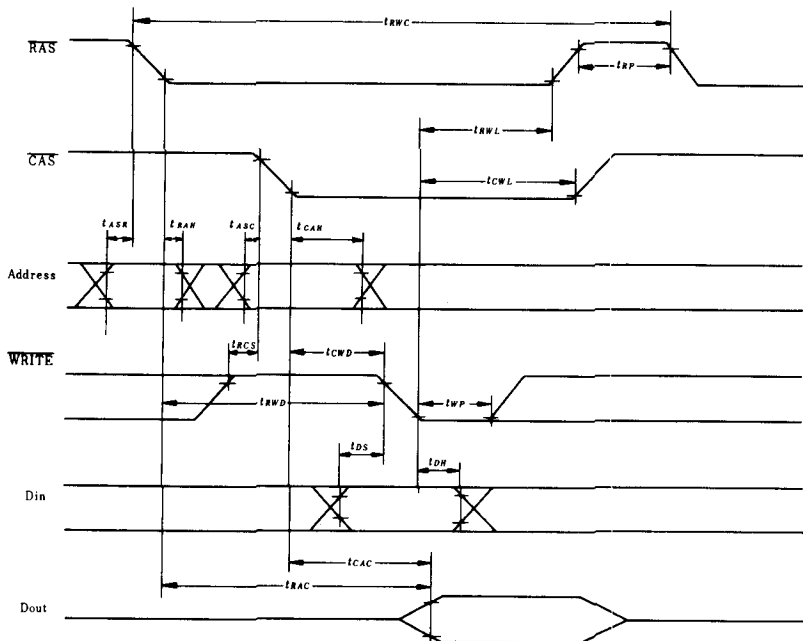
● READ CYCLE



● WRITE CYCLE

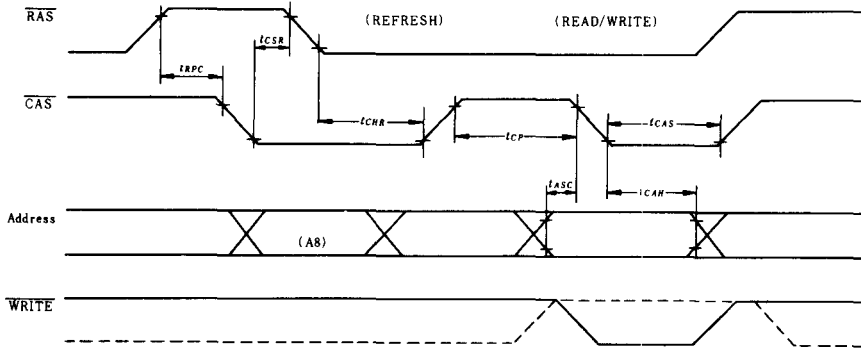


● READ MODIFY WRITE CYCLE





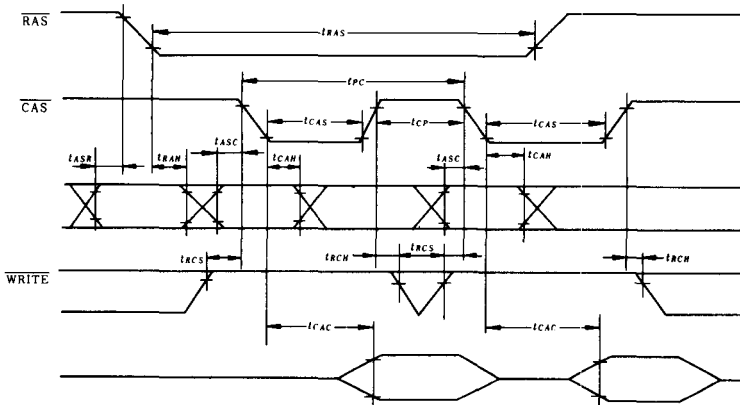
● COUNTER TEST



■ PAGE MODE CHARACTERISTICS ( $T_a=0$  to  $+70^\circ\text{C}$ ,  $V_{CC}=5\text{V}\pm 10\%$ ,  $V_{SS}=0\text{V}$ )

Parameter	Symbol	HM50256/P-12		HM50256/P-15		HM50256/P-20		Unit
		min	max	min	max	min	max	
Page Mode Supply Current	$I_{CC1}$	—	57	—	48	—	37	mA
Page Mode Read or Write Cycle	$t_{PC}$	120	—	145	—	190	—	ns
CAS Precharge Time, Page Cycle	$t_{CP}$	50	—	60	—	80	—	ns
Page Mode Read Modify Write Cycle	$t_{PCM}$	165	—	195	—	250	—	ns

● PAGE MODE READ CYCLE



● PAGE MODE WRITE CYCLE

